Next Generation X-ray Timing

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Name of Technology (256 char)	Pixelated Large-Area Solid State X-ray Detectors	Low-Noise, Low-power ASICs for Solid State Detectors	Thin, Lighweight X-ray Collimators
Brief description of the technology (1024)	X-ray timing science objectives call for achieving several square meters of X-ray sensitive collection, over range 2-30 keV, obtaining time of arrival and energy for each photon. Silicon pixel arrays, silicon drift detectors, pixel arrays of high-Z materials, or hybrids are possible choices but all need development.	Low power ASICs are needed to provide accurate time of arrival and energy for each photon but with low aggregate power per square meter.	Requirements of new X-ray timing instruments built around solid state elements require re-thinking design of the collimator unit that provides source isolation. In order to not dominate the mission mass and volume budgets, the collimator must be much thinner and lighter than previous honeycomb colllimator designs.
Goals and Objectives (1024)	The goal is to achieve large area detectors that are thick enough to have significant stopping power above 30 keV. The technology should reach TRL 6 in by 2014, to meet opportunities for near-term explorers.	The ASIC must achieve noise performance good enough to allow a low energy threshold of <= 2 keV and and energy resolution <= 600 eV with a total power budget less than 100 W/m^2. The ASIC must reach TRL 6 by 2014 to meet opportunities for near-term Explorers.	The goal is to produce collimators with FWHM <= 1 deg that are <1 cm thick, and have stopping power sufficient to effectively collimate X-rays at 50 keV.
TRL	TRL is between 4 and 5. Requires efforts towards space qualification and testing in relevant environment.	TRL is 3. Portions of the functionality have been demonstrated but a full prototype that meets both the noise and power requirements has not yet been produced.	TRL is 3 for new designs. Prototyping for new concepts has only begun
Tipping Point (100 words or less)	Designs have reached TRL 4. A focused effort could increase this to TRL 6. A few cycles of fabrication and test are realistically necessary, but must be coordinated with ASIC development.	The ASIC is the key ingredient in achieving a system that meets the performance requirements. One successful design and fabrication will allow systems to be tested in relevant environments. An ASIC within power requirements needs to be demonstrated, mated to a detector	Prototypes exist involving nano-fabrication using high-Z materials to deliver performance at higher energies.
NASA capabilities (100 words)	NASA's capabilities support test but pixel arrays are custom procurements from commercial sources.	NASA's does not have an engineering group producing custom ASICs of this kind but suitable groups exist in DoE or at commercial sources.	NASA has nano-fabrication facilities but they also exist in other government departments and in industry.
Benefit/Ranking	Ranking: iii. The transition of X-ray missions from gas proportional counters to solid state designs will allow a 5-10x increase in effective area and a quantum leap in detector reliability.	Ranking: iii. The ASIC is the principal limiting factor for the power budget, energy resolution, time resolution. ASIC performance directly translates into mission performance improvements.	Ranking: iii. Older collimator designs are needlessly high in areal density (gm/cm2) and have vertical thickness that is disadvantageous if detector units are stacked for launch and then deployed. Older collimator designs can needlessly dominate the mass budget for explorer-class missions.
NASA needs/Ranking	Ranking: iii. Pixelated silicon detectors of this type can be applied to various missions that need large area X-ray timing, wide-field imaging, and spectroscopy.	Ranking: iii. Low power, low-noise ASICs coupled with pixelated silicon detectors of this type can be applied to various missions that need large area X-ray timing, wide-field imaging, and spectroscopy.	Ranking: iii. Thin, light collimators with good stopping power can be used in a variety of NASA and laboratory settings.
Non-NASA but aerospace needs	Ranking: ii. Such devices might be used in certain envisioned applications such as X-ray navigation of satellites.	Ranking: ii.Such devices might be used in certain envisioned applications such as X-ray navigation of satellites.	Ranking: ii. Collimators might function in flight X-ray systems for applied uses.
Non aerospace needs	Ranking: i. Non space-qualified systems exist to meet non-space needs such as inspections.	Ranking: i. Similar ASICS have commercial applications, but any connection is really via maintaining development teams that can support space and non-space needs.	Ranking: ii. Such collimators could be used for X-ray detector systems on the ground where collimation was a requirement

Technical Risk	Ranking: ii. Technical risk is low. The design principles are generally understood but progress comes through design iterations to refine performance based on completed units.	Ranking: iii. Technical risk is moderate given access to (rare) analog ASIC design expertise. The history of analogous flight projects shows this task must not be underestimated.The main challenge is to get low power with low noise.	Ranking: iii. Technical risk is moderate for completely new approaches. Lacking such investment there would be fallback to older designs mis-matched to requirements, resulting in sub-optimized mission performance.
Sequencing/Timing	Ranking: iv. Should come as early as possible. Development of other system components depends on detector unit parameters. Some ongoing development under NASA APRA.	Ranking: iv. Should come as early as possible. Development of other system components depends on ASIC power performance. No active US program. Europeans modifying particle physics detectors.	Ranking: iv. Should come fairly early in mission development because it drives overall system characteristics.
Time and Effort to achieve goal	Ranking: iv. 3 year collaboration between industry and NASA	Ranking: iv. 3 year collaboration between industry and NASA	Ranking: iv. 3 year collaboration between industry and NASA